ee, Robert E. K. D.
1957

Richard Brock

EXPANDED TECHNICAL ASSISTANCE PROGRAM

FAO Report No. 739

To Mr. Vernon Brock
With the compliments
of the author.
Robert E. K. D. Lee

Report to the Government

of

BRAZIL

on

TUNA FISHERIES DEVELOPMENT

(Northeastern Coast of Brazil)

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

ROME, 1957

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Project BRA/Fi

REPORT

to the

GOVERNMENT OF BRAZIL

on

TUNA FISHERIES DEVELOPMENT

(Northeastern Coast of Brazil)

based on the work of

Robert E. K. D. Lee

FAO/ETAP Fishery Engineer

Rome, 1957

FAO/57/11/7464

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CONTENTS

		Page
I.	INTRODUCTION	1
II.	GENERAL OBSERVATIONS ON THE FISHERIES OF THE NORTHEASTERN COAST OF BRAZIL	2
	A. Fishing Craft	2
	1. Jangadas	2-3
	2. Jangada-Bote	3
	3. Botes (sailing boats)	3
	4. Canoas (canoes)	3
	5. Motorized fishing craft	3
	B. Tuna Fishing in the Northeast	4
	1. Description of trolling gear used by local fishermen	5
	C. Other Methods used for Fishing	5
	1. Linha de Fundo (handlining)	5
	2. Currais (fish traps)	5
	3. Covos (fish pots)	6
	4. Viveiros (fish ponds)	6
	D. Harbors and Facilities	6-7
	E. Boatyards	7
	F. Fish Production	7-8
	G. Fish Distribution	8-9
	H. The Fishery at Fernando de Noronha	9
	I. General Weather Observations	10
	J. Escola de Pesca de Tamandare	10
III.	FISHING BOATS USED FOR DEMONSTRATION FISHING	11
	1. "Tamandare I"	11
	2. "Leste"	11
	3. "Albacora"	11-12
IV.	FISHING METHODS DEMONSTRATED BY EXPERT	13
	1. Multiple trolling (corso)	13
	2. Tuna longlining	14
	a) Description of gear	14-15
	b) Longline bait	15
	c) Assembling the basket	15-16
	d) Setting the gear	16
	e) Hauling the gear	16
	f) Use of bathythermograph	17
	g) Species taken by longlining	17

Page

3. Pole and line (or live-bait) fishing 17-18
   a) Description of pole fishing gear 18.
   b) Bait fishing 19-21

V. JAPANESE TUNA FISHING OFF THE BRAZILIAN COAST 22-23

VI. CURRENT PROGRESS ON TUNA FISHING DEVELOPMENT 24

VII. CONCLUSIONS 25-26

VIII. RECOMMENDATIONS 27-28

TABLES

1. Mototized fishing craft in Pernambuco and Paraiba 4
2. Average monthly catch and earnings for each type of craft (1956) 8
3. Average yearly fish production and value -
4. Species of fish taken by tuna longlining 17
5. Main species of fish taken by the "Kaiko Maru No.13" - First trip 22
6. Composition of catch taken by the "Kaiko Maru No.13" - Second trip 22
7. Dates and location of best catches taken by the "Kaiko Maru No.13" Second trip 22
8. Summary of data for the "Kaiko Maru No.13" - First two trips 23
9. Fish prices for the "Kaiko Maru No. 13" catch 23
10. Taxes imposed on the "Kaiko Maru No.13" catch 23
11. Prices of inboard engines manufactured in Brazil 25

APPENDIX

A. List of fishes (other than tuna) mentioned in the present report

B. Charts

1. Fishing stations of the "Albacora" from October 1955 to January 1957
2. Longline fishing stations of the "Kaiko Maru No.13" from 29 July to 31 August 1956

C. Illustrations

1. Diagram showing construction of gear for multiple trolling
2. Diagram showing construction of longline gear - Part I
3. Diagram showing construction of longline gear - Part II
4. Diagram of bamboo pole used in pole fishing for tuna

D. Photographs, 1 - 22.

I. INTRODUCTION

Following a request by the Government of Brazil for technical assistance in fisheries, a fishery engineer (master fisherman), Mr. Robert E.K.D. Lee (U.S.A.) was appointed by the Food and Agriculture Organization of the United Nations (FAO) to this assignment and, after briefing at the FAO Regional Office in Washington, D.C. arrived in Recife in February 1955. Having completed his assignment at the end of January 1957, he proceeded to Rio de Janeiro and then to FAO Headquarters in Rome, to prepare this final report on his work.

Under Supplementary Agreement TA 273/S/21 between FAO and the Government of Brazil, the duties of the expert were as follows:

> "to advise and assist the Government in carrying out experimental fishing operations and to advise on various types of fishing craft and gear that may be used most effectively within the country. Also to train Brazilian technicians in this field".

Pursuant to reports of large concentrations of albacore during certain parts of the year in the northeastern region of Brazil, principally off the coast of the States of Rio Grande do Norte and Paraiba, and with a view to developing these tuna resources, the expert's work was mainly confined to the northeastern area. It is also for this reason that Mr. Lee, who is a specialist in tuna fishing, was recruited for this assignment. Although a number of other States are included in the northeastern group of Brazil, only the coastal waters of Pernambuco, Paraiba and Rio Grande do Norte which are known to be rich in tuna are referred to in this report. The general condition of fisheries in this area is described in Chapter II, "General Observations on the Fisheries of the Northeastern Coast of Brazil."

II. GENERAL OBSERVATIONS ON THE FISHERIES OF THE NORTHEASTERN COAST OF BRAZIL

A. Fishing Craft

In the States of Pernambuco, Paraiba, and Rio Grande do Norte of the northeast, there are about 9,000 fishermen engaged in fishing. The approximate number of fishing craft is 900 canoas, 1,200 jangadas and 300 botes.

1. Jangadas

This type of craft is used almost exclusively in the northeast. It is a raft made of lightwood called "Piuba", "Peiba" or "Apeiba" (Apeiba tibourbou Tiliaceae) but better known by the fishermen as "pau de jangada." Formerly, the jangadas were called "igarapeba", literally meaning "flat craft."

The jangada (see Figure I) is usually made up of six logs held together by woodenpegs, driven through the logs at several places. The average size of a seagoing jangada is about 6.1 meters long and 1.37 meters at its widest part. The bow and after part of a jangada tend to be a little narrower than the center and there is also a slight dip from the sides to the middle. There are two small benches near aft, one of which is used by the helmsman. A little aft of center, there is a stand for securing the fishing lines.

The rudder is a flat wooden piece about 30 centimeters wide and 2.1 meters long, with one end shaped so that it can be gripped. The rudder is placed in the crack between the two innermost logs, which are used for bracing the rudder. There is a mast one third of the way aft of the bow with a "Bermuda" sail, which is the only means of propulsion. The position of the mast can be changed to different angles by moving the base of the mast to other holes in the flat board on which it rests.

A center board, 30.5 centimeters wide and 122 centimeters long, is used as a keel. This protrudes through the deck and can be regulated. A large stone encased by several sticks tied together is used as anchor (killick). A wooden spoon for wetting the sail, a large basket in which the catch is kept, a container for food, a water jug, fish gaff, and the fishing lines make up the rest of the equipment.

Jangadas are comparatively light in weight and are able to move with the slightest breeze. The jangada, which is manned by a crew of two or three called "jangadeiros," return from fishing daily and have to be beached after each trip, which is done by pulling it out of the water onto coconut stumps used as rollers in getting the jangadas further up the beach. Sometimes the fishermen have a difficult time beaching their craft because they often capsize when coming in over the surf. Because they tend to ger waterlogged, jangadas are not suitable for daily trips. This situation is especially true after the jangadas have been used for some time.

These craft are mainly used for trap fishing, going as far as 12 miles offshore. Traps are set mainly for lobsters and small table fish in waters 10 to 15 fathoms deep.

2. Jangada-bote

A jangada-bote (see Figure 2) has the same general characteristics of a jangada, except that it has a hull and deck of planked wood. It varies from 6 to 7 meters in length, measuring about 1.5 meters at the widest part. The craft has a shallow draft and a deck arrangement similar to that of a jangada. The cost of a jangada-bote is about Cr.$18,000.00. Although it is supposedly an improved version of a jangada, it is not favored by the fishermen, who seem to have more confidence in their original jangadas.

3. Botes (sailing boats)

Most of the craft engaged in tuna fishing are botes (see Figure 6) which are sailboats generally 6 to 9 meters in length with 1.80 to 2.3 meters beam propelled by two main triangular sails. When trolling for tuna, only one sail and a jib is used. There is a fish hold of 1½ to 2-ton capacity, with a partitioned section aft for the storage of fishing equipment and sleeping accommodations for two.

The botes have a fixed deck, making it possible to sail and fish on the high seas. They are used primarily for handlining and trolling. Where ice is available, they take aboard 10 to 12 blocks (250-300 kg.) of ice. The ice is wrapped in newspaper, then covered with burlap, canvas or sawdust. The ice lasts about three days in the non-insulated holds. Where the fishermen are unable to obtain ice, the tuna is salted.

4. Canoas (canoes)

Canoas, which use paddles for propulsion, engage mostly in inland fisheries in the ports, inlets, rivers and estuaries. Their length ranges from 4 to 7 meters and the width is about 61 centimeters. Rarely does a canoa go beyond the reefs, as it is not very seaworthy. Fishing with canoas, therefore, is restricted to the inland waters, usually using nets for tainha, sardinha and manjuba (see Appendix A).

5. Motorized - Fishing Craft

Prior to the expert's arrival in Recife, there were only two motorized craft engaged in commercial fishing in the three States of Pernambuco, Paraiba and Rio Grande do Norte. This figure has since increased and there are now five boats.

Table I. Motorized Fishing Craft in Pernambuco and Paraiba

Name of Vessel	Length	H.P.	Port
Lesto	10 meters	10	Recife, Pernambuco
Zulmira	11 "	50	" "
Saldanha da Gama	18 "	140	" "
Santa Alice	19 "	120	" "
Almirante Frederico Vilar	11 "	50	Joao Pessoa, Paraiba

In addition, the Escola de Pesca de Tamandare has three motorized vessels.

Tamandare I	8 meters	10	Tamandare, Pernambuco
Tamandare II	11.5 "	30	" "
Albacora	11.5 "	30	" "

B. Tuna Fishing in the Northeast

Although there have been reports that tuna is occasionally caught in other areas off the coast of Brazil, commercial tuna fishing is done only in the northeast region of Brazil. This fishery is carried on by about 150 to 200 sailing boats called botes varying from 6 to 9 meters in length, normally carrying a crew of three, operating from Paraiba and Rio Grande do Norte. Most of the tuna fishing is centered around Baia Formosa, where the bulk of the fleet is based. During the season botes totalling about a hundred from as far as Caiçara concentrate in this bay. Baia Traicao, Natal and Rio do Fogo account for the remainder of the tuna fishing fleet.

Tuna fishing is carried out on a small scale, either by trolling or handlining, during the tuna fishing season, from September to December only each year. Occasionally jangadas are seen in the tuna fishing area but they are gradually being replaced by botes. Trolling for tuna is done near the edge of the continental shelf in depths of about 35 fathoms with temperatures of 25°C. to 26.7°C. The botes fishing for the fresh fish market leave in the morning and return at night. Otherwise, salt is taken and then the boats usually remain at sea for three days.

During the tuna fishing seasons of 1953 and 1954, a bote was estimated to have produced an average seasonal catch of 1.2 tons. The production of tuna for the two years was estimated to have been 200 tons annually. The tuna landings for the years 1955 and 1956 showed a sharp drop, the estimate being only half that of the previous two years.

1. Description of trolling gear used by local fishermen

The principal method for catching tuna is by trolling with one line at a speed of 4 to 5 knots. Two lines are used but only one for trolling at any one time. The alternate line is pre-baited and as soon as a fish is landed, the alternate line is then paid out.

The length of the trolling lines vary from 65 to 100 fathoms but only 35 fathoms is paid out while trolling, the line being marked at this length. The lines are hard-laid cotton 3 millimeters in diameter and usually treated with a preservative called cupuna, which is extracted from the bark of the cupuna tree. The hooks used are Mustad round bent sea hooks, flatted galvanized extra strong, numbers 573, 574 and 575. The leader wire is a 3-stranded 0,9 millimeter stainless steel wire about 60 centimeters in length, which is secured to the hook with fine brass or copper wire. Secured to the other end of the leader wire are about 3 to 5 meters of white cotton line called curati, usually smaller in diameter than the main line, this line being tied to the main line.

Bait commonly used for trolling are pira, agulha, tainha (see Appendix A) and the bellies of the tuna. Selected fish of 20 centimeters are scaled and filleted and the hook passed through the fillet so that, while trolling, the skin of the fish faces down, while the point of the hook faces up. The hook is passed through the fillet about one third of the way from one end, this smaller portion then being secured with cotton twine to the wire leader near the flatted end of the hook.

C. Other Methods used for Fishing

1. Linha de fundo (handlining)

Handlining is the most commonly used method for fishing. Present catches of bottom fish from the coastal waters indicate that bottom fishing is not very productive. Catches brought in by the "Saldanha da Gama" and the "Santa Alice", show that the more productive fishing grounds are located around the Atol das Rocas and Fernando de Noronha Island. However, these fishing grounds cannot be reached by the small craft, which are limited to fishing in coastal water.

2. Currais (fish traps)

Fish traps are common along the coast of the northeast. They are made with straight, selected tree branches and set in about 2 to 3 fathoms of water. These traps fish sporadically and occasionally good catches are made. Species taken by this method are bagre, barbuda, camorin, curimã, espada, guarajuba, tainha, galo and sargo (see Appendix A).

3. Covos (fish pots)

Fishing with covos is mainly done by the jangadas. The covos are set and weighted down in 10 to 12 fathoms of water and marked by a wooden or bamboo float attached to the trap with a length of line. The fishermen go out every other day with their jangadas to make a routine check of their covos. During the rough season or when there are strong currents, covos are often carried away or lost. A covo (see figure 5) costs about Cr. $150.00 and is made of woven strips of cana brava having openings of about 3.8 centimeters between strips. The entrance to the covo is tapered. This gear catches mainly spiny lobsters (Palinurus sp.) and small bottom fishes.

4. Viveiros (fish ponds)

It is estimated that there are about 400 viveiros in the State of Pernambuco. The viveiros supply the markets with large amounts of fresh fish. During the stormy season, they supplement the meager catches brought in by the small fishing craft. The important species taken from these viveiros are curimã, camorim, tainha, carapeba and pescada (see Appendix A).

D. Harbors and Facilities

In the northeast there no docking facilities for fishing boats, although the ports of Recife, Cabedelo and Natal provide good shelter for small fishing craft. These craft usually go to the docks for loading and unloading but are otherwise anchored or beached. There are no facilities for taking on fuel, water or ice. Fuel is usually bought at some service station and carted in barrels to the vessel and then siphoned or pumped into the vessels' fuel tanks. For water, the fishermen have to carry water in buckets or barrels to the vessel. Each of the three ports has large water hoses for steamers but, even if these were usable, they are not available to the fishermen. Ice is carried from the entreposto (ice plant with facility for storage of fish in small quantities up to 4 tons) to the vessel by hand. Boats usually wait for high tide to take on ice as it is easier to load on at this time (see figures 6 and 7).

The entrepostos, operated by the "Caixa de Credito" of the Ministry of Agriculture, do not produce enough ice, nor do they have enough refrigeration space. The ice from the entreposto is sold to the fishermen at Cr. $10.00 per 25 kilograms block but the entreposto in Natal does not produce ice and the fishermen there pay Cr. $24.00 per 30 kilograms block elsewhere. Storage charge at the entreposto is Cr. $0.30 per kilogram and Cr. $0.70 per kilogram elsewhere. The daily production of the ice plant in Natal is 2 tons, while that of the entrepostos in João Pessoa and Recife (see figure 3) is $2\frac{1}{2}$ and 4 tons, respectively.

The entreposto in João Pessoa is badly located, i.e. not readily accessible to boats. Although it is located next to a river, the river is navigable only with a skilled pilot.

Generally, when boats require small repair work done on the hull, they are beached at high tide and supported with wooden braces. Work on the hull is done only at low tide. When major work to the hull or other parts require complete dry-docking, a crane is used to lift the vessel out of the water and place her on the docks to be braced with block wood.

E. Boatyards

The boatyards in this region are poorly equipped and generally capable of building only small boats. These boatyards engage in the construction and repair of the wooden parts of the vessel. They are not able to install engines, lacking trained personnel to do this. However, a few boats have had engines installed, but this was poorly done. In the fishing villages, the craft are usually built by the fishermen themselves rather than by anyone primarily engaged in boat building.

There are three boatyards in the State of Paraiba equipped to build large boats. The "Estaleiro Canalau" and "Estaleiro Adelino Honorio" are located in Cabedelo and the "Estaleiro Joaquim Lima" is in Acaú. The latter, which built the "Albacora", has ten employees and seems to be a family enterprise. The boatyard is equipped with a 18 h.p. one-cylinder diesel engine that operates two saws, 2 planers, and a grindstone by belt drives. Nails and spikes are made from galvanized rods cut into desired lengths and the ends are pounded with a hammer to form the heads. Lumber of uneven thickness used for hull planking and decking is nailed on and later trimmed with an adze. The methods used are primitive and the work is crude.

A boat's bottom part is usually applied with hot tar, although there are many craft using cheap paint which does not resist the penetration of teredo worms, necessitating frequent change of hull plankings. Although anti-fouling bottom paint is available, few of the fishermen use it.

In the port of Natal, there is a navy dry dock capable of dry-docking large vessels. The shore installation is equipped with a machine, welding, woodworking, and metal shop.

F. Fish Production

There are no reliable data on fish production in the northeast. The only source of information is the monthly report on fish catches by each "Colonia dos pescadores" which is sent to the Inspectoria Regional de Caça e Pesca. Reports are not turned in regularly and the catches reported are below the actual amounts taken.

The following table is the average monthly catch and earnings estimated for each type of craft for 1956 based on these monthly reports.

Table 2. Average Monthly Fish Catch and Earnings for Each Type of Craft (1956)

Type of craft	Catch	Monthly earnings
Canoa	154 kilograms	2,071 Cr.$
Jangada	196 "	2,977 "
Bote	131 "	2,114 "

According to information from the Departamento Estadual de Estatistica, fish production and value in Pernambuco for 1952/1954 is as follows:

Year	Catch	Value
1952	931,098 kilograms	8,587,080 Cr.$
1953	931,175 "	10,046,137 "
1954	1,166,046 "	13,938,299 "

G. Fish Distribution

Most of the fish catches are purchased by middlemen who sell the fish to the retailers in the markets and to the street vendors. A fiscal agent of the "Caça e Pesca" is usually present to check and record the weight of the fish catches in order to determine the amount to which the "Caixa de Credito" 3 percent tax should be applied.

In Recife, most of the fish catches are sold in the São Jose market. The fishes are displayed on tables without any ice or refrigeration. Because of this situation, it is common practice among the fishermen to eviscerate the fish after catching them.

Fish are sold in the morning, up to midday. After the noon hour, the fish are kept in a chilled room until the next day. The condition of the fish is generally satisfactory, but some fish being marketed are unfit for human consumption. Fish is also sold, unrefrigerated, by the vendors who go from house to house, and at the open fish stalls along the beaches (see Figure 4). At the fish stalls, the viscera and scale removed from the fish are discarded on the spot and left there.

Generally, only the inhabitants along the coast have the opportunity to buy fresh fish. Some of the fish sold in Recife are brought by truck, poorly packed in ice and sawdust, from the fishing villages of Baia Formosa, Caiçara and Rio do Fogo of Rio Grande do Norte. Some fish are brought from Fernando de Noronha, either by plane or boat. Fish sent to the interior are either smoked, salted or dried.

Lack of cold storage facilities is one of the main reasons for inadequate fresh fish distribution to the interior of the northeast. Although there is rail transportation to the interior and roads are adequate, the main reason for the inadequate distribution of fresh fish is the lack of effort to organize it.

H. The Fishery at Fernando de Noronha

The island of Fernando de Noronha, covering an area of about 22 square kilometers, is situated 290 miles north-northeast of Recife. Formerly a penal colony, it is now occupied by the military and has about 1,000 inhabitants. The island has a military governor who has shown great interest in the development of the island's fishery. The fishery on the island has made rapid strides within the past year. In early 1956, there were only two jangadas, three 6-meter boats and 24 fishermen on the island. This figure has now been increased, bringing the total to 20 jangadas, 4 botes, and a 19-meter trawler, and about 100 fishermen. There are two 11-meter boats near completion in Cabedelo, Paraiba, which are to be bought and used by the island. The amount of fish sent from the island to the Recife market has increased from about 5 tons per month in early 1956 to 25 tons per month at the end of the calendar year. The landings are expected to be greater in 1957, as the 19-meter trawler, "Santa Alice", will be equipped to do longlining there shortly. The vessel arrived in Recife in September 1956.

According to the fishermen on the island, tuna schools are present all the year round. During a trip to the island, tuna schools, accompanied by flocks of birds, were observed only three miles from shore. The fishermen do not go after these schools as the fish travel faster than their sailing craft. Furthermore, the fishermen seem to be content with bottom fishing with handlines, which allow them to catch fish with lesser effort. Occasionally, tuna is taken while trolling to and from their fishing grounds and also with handline, while bottom fishing.

Fish usable for bait, such as sardinha cascuda (see Appendix A), found in the bays, are abundant and because their behavior is rather tame they can be easily caught with a cast net. The fish are used as bait for trolling and handlining.

Fish caught commercially from Fernando de Noronha are not very popular at present on the mainland markets. People in Recife, João Pessoa, and Natal have been hospitalized due to fish poisoning after eating fish from the island.

At the request of the Governor for help with this problem, the expert was able to enlist the services of Dr. Bezerra Coutinho of the Laboratorio Bromatologico, to examine fish specimens from the island sent by the Governor. These were found to be non-poisonous. However, it must be noted that examinations were not made of all the fish sent to market from the island. Furthermore, each species should be checked all year round, as it is believed that some fish are poisonous only during certain times of the year.

I. General Weather Observations

Southeasterly trade winds prevail throughout the year with occasional interruption of northeasterly and easterly winds. The climatic conditions are fairly uniform, with air temperatures varying from 25.6°C. to 28.9°C. The annual sea surface temperatures recorded vary from 25.0°C. to 27.2°C.

Generally the rainy season is from April to July, with fairly strong winds occurring from May to August, sometimes extending to mid-September. Fishing almost comes to a standstill during the season when seas are rough and winds are strong.

J. Escola de Pesca do Tamandare

The Escola de Pesca do Tamandare (Fishery School of Tamandare) was established by the Government mainly for teaching the profession of fishing and for providing general education, priority being given to the sons of fishermen. The school was inaugurated in August 1954 with an enrollment of 100 students. At present, there are about 130 students ranging from 16 to 25 years of age, with provisions being made to increase the enrollment. There are entrance examinations, and to qualify, a boy must pass at least half of the examination. There are no tuition fees and room and board are provided free. The staff consists of a director, three professors and three masters for the practical aspects of training. The course includes seamanship, fishing methods, and related subjects. Students from the school have participated in the fishery operations on the "Albacora" and some have made a trip on the "Kaiko Maru No. 13".

III. FISHING BOATS USED FOR DEMONSTRATION FISHING

1. "Tamandare I"

The "Tamandare I" (see Figure 8), an 8-meter boat, was the first vessel provided by the Government for use by the expert. It was powered by a 10 h.p. "Drotot", one-cylinder diesel engine and an emergency gaff-rigged main sail and a jib. Several trips were made out to sea but each time the boat returned to port by sail because of engine failure. It was rigged with two 6.5-meter jib poles but no fishing was ever done.

2. "Leste"

The "Leste", a 10-meter boat, was chartered for a short period after the unsuccessful fishing attempts with the "Tamandare I." It had a 10 h.p. kerosene engine with a lateen sail. Since the engine was not equipped with a cooling pump, it was cooled by gravity from a 113-liter barrel secured on deck, which had to be filled every ten minutes with buckets of sea water. Two jib poles were mounted for trolling but this vessel also suffered engine breakdowns, which made fishing impossible.

3. "Albacora"

The only vessel on which fishing was actually done was the "Albacora" built for the Fishery School of Tamandare. The vessel was contructed of wood by the Joaquim Lima boatyard in Acaù, Paraiba started in October 1953, it was completed in 1955.

The "Albacora" (see Figure 9 and Illustration 1), 11.45 meters long, with a 3.60-meter beam and a draft of 1.25 meters. The main engine is a 30-h.p. Hanseatische Motoren Gesellshaft (HMG) 2-cylinder - 2-stroke cycle diesel engine. The auxiliary is an 1 KW dynamo driven by a 3 h.p. gasoline engine. There are four fuel tanks with a total capacity of 920 liters which give the vessel a cruising range of 688 miles at 4.5 knots. The original plans called for only two 150-liters fuel tanks.

A fresh water tank of 344 liters was secured on deck. For propulsion, it was also equipped with a gaff-rigged main sail and a jib. Although the vessel was designed to make 8 knots, under favorable conditions and with the use of sails, the maximum speed obtained was 5 knots.

The fish hold had a 3-ton loading capacity, being insulated with 11.5-centimeter cork. A section of the fish hold was partitioned off to make 2 live bait wells, also usable for storing fish. During longlining, the wells were used as storage space for the glass floats. Each bait well, with its interior painted white, had an opening on deck which was encased with a coaming 30 centimeters in height to prevent slopping of the water while under way (see Figure 13). Just above deck level was a 7.6-centimeters outlet and pipe from the side of the coaming which led overboard. Each tank had a capacity of 1,060 liters of sea water which was circulated by a 5.1-centimeter pump driven by a $1\frac{1}{2}$ h.p. gasoline engine. The pump could also be driven with V-belts by the power take-off of the main engine. Water was pumped at the rate of 95 to 190 liters per minute, depending on the mechanical condition of the pump and the speed of the main engine while under way.

For longlining, the "Albacora" was equipped with a net gurdy (see figure 10), provided by FAO, which is driven by the power take-off of the main engine. For pole fishing, it was equipped with four removable fishing racks mounted on her port quarter. In addition, there were also a 20-centimeter magnetic compass, chronometer, sextant, and a 6 V. Bendix Depth Recorder of 75-fathom (137 m) range (also provided by FAO).

When first built, the "Albacora" had accommodations for only two but later, an addition to the pilot house increased this figure to five.

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IV. FISHING METHODS DEMONSTRATED BY EXPERT

Three different methods of fishing for tuna were used on the "Albacora", namely, multiple trolling, tuna longlining and pole and line fishing (see illustrations 2, 3, 4 and 5).

1. Multiple trolling (corso)

The jig poles were of rounded wood cut to 7.5-meter length. The base was 7.6 centimeters which tapered to 5 centimeters at the point of the pole. The base of the pole was fastened to a mount which allowed the pole to move vertically and also to revolve in a horizontal position. The poles were mounted to the rails of the boat, supported by guy lines from the mast and lines from the bow of the ship. When trolling, the poles were lowered to a position forming a 20° angle with the surface of the water. When not in use, the poles were secured in a vertical position to the mast.

The trolling lines used are No. 96 hard-laid cotton twine, 3 millimeters in diameter. Strong rubber shock absorbers were used on each trolling line to reduce the initial impact of the fish strike. Absorbers were secured to one end of each line and a slack of 38 centimeters of line was left to allow for the stretch of the rubber. Swivel attachments were spliced to the lower end of the lines with Nos. 14 and 18 stainless steel leader wires of 1.2 meters in length attached to the swivel. The various types of jigs used were whalebone jigs, plastic head-feathered jigs, and chrome-plated metal head-feathered jigs. A No. 40 or 50 double hook was made fast to the leader wire.

Six lines spaced 3 meters apart were used during trolling operations. The seventh line was secured to the stern of the vessel. The outboard lines were 35 fathoms, center lines 30 fathoms, and the inboard lines 25 fathoms in length. This arrangement made it possible for the different lines to be hauled in without tangling with the others. Lines were attached to the outboard and center lines a short distance aft of the jig poles to facilitate retrieving the trolling lines.

Most of the fish caught were taken while the vessel was doing a speed of 4.5 knots. Very few fish were taken at reduced speeds, indicating that the speed of the vessel was an important factor when trolling. Although trolling during the season was carried out from 06.00 to 17.00 hours, tuna was best taken in the morning between 06.00 to 09.00 and between 15.00-17.00 in the afternoon. Big-eyed tuna, 2 to 6 kilograms, was the kind and size of tuna which made up most of the catch. Small amounts of skipjacks and frigate mackerel were also taken. During the incidental trolling to and from the fishing grounds, very few fish were taken. Of the various artificial lures tried, best results were obtained with the plastic feathered jigs.

Trolling below the surface with "Stim" paravanes was tried but not a single fish was taken during the course of the experiment. It was observed that there was heavy tension on the lines at a speed of 4.5 knots. Slower speeds were tried but the lures did not react at the reduced speeds.

2. Tuna longlining

The longline method is presently the best known method for catching subsurface tunas and spearfishes. This method has been highly developed by the Japanese. The longline gear is designed to catch the deep swimming fishes by means of a series of baited hooks placed below the surface of the water. This kind of fishing employs one long drifting main line, supported at intervals by lines attached to floats, with a series of fishing lines attached to the main line. The longline gear is made up of units referred to as "baskets" so called because it was originally stored in split bamboo baskets.

Longlining was the most successful method of taking tuna employed by the "Albacora". Thirty-nine sets averaging 20 baskets fishing 120 hooks per set took a total of 9,850 kilograms of fish, 35 percent of which were tunas.

a) Description of gear (see illustrations 3 and 4)

The following is a description of the gear obtained from Japan by FAO.

Mainline. The lines were extra hard-laid cotton twine 6 millimeters in diameter, which had been soaked in tar. Each basket contained 14 main line sections, each 12½ fathoms long with 30-centimeter eye splices on both ends of each length. Thus, one basket contained a total of 175 fathoms of mainline.

Branchline. Although there were 13 branchline attachments to a basket, only 6 branchlines were used, so that the hooks were spaced twice as far apart; i.e. 25 fathoms or 45 meters.

The branchline consisted of six pieces:

i) A 5-fathom or 9-meter length of 6 millimeters hard-laid cotton twine with a mathew walker knot on one end and an eye splice through the ring of a swivel on the other.

ii) A "No. 10 brass swivel".

iii) A 5-millimeter hard-laid cotton twine with an over-all length of 60 centimeters passed twice through the ring of the swivel and seized near the ring with a No. 6 cotton line. The two ends were secured with a wall knot. This short length is used in making a double sheet bend on the eye of the sekiyama.

iv) A sekiyama, which is a No. 27, 3 x 3, 1.5-millimeter galvanized steel wire, around which is tightly and closely wound a No. 6 cotton twine, provides a good gripping surface. It is 3.9 meters in length with a 7.5-centimeter eye at each end and is also treated with tar. The sekiyama being rigid, prevents the lower section of the branchline from fouling when a fish is hooked, and thus reduces the visibility of the branchline near the hook.

v) A leader wire is a 1.8-meter length of No.27, 3 x 3 galvanized steel wire. At one end of the wire is a 7.5-centimeter eye which is wrapped with No.6 cotton twine to minimize the wear of the sekiyama. A hook is secured to the other end of the wire leader.

vi) A hook is made of tempered steel 5 millimeters in diameter. The size used was 3.8 sun, which is equivalent to an 8/0 tuna hook.

Floatline. The floatline is 10 fathoms or 18 meters long with a 30-centimeter loop at one end and a mathew walker knot at the other. The loop end is attached to the main line and the knotted end to a loop on the butt of a bamboo pole.

Poles with flags. Poles with flags are attached to the floats to facilitate locating the gear and to mark the joining of the baskets. The bamboo poles are about 4 meters in length, having a diameter of 3 centimeters at the butt and a diameter of 1.2 centimeters at the tip. A glass flat is secured to the pole about two fifths of the way up from the butt of the pole. A 23 x 30-centimeter rectangular orange or white flag is secured to the upper end. Orange flags, which are easier to locate during the day, than white flags, were used. However, the white flags are easier to spot when retrieving the gear at night.

At a point on the pole slightly above where the float is secured, a length of rubber strip is wound and secured, to protect the pole from chafing on the glass float. At the base of the pole, a 15 centimeter loop of 6-millimeter manila rope is fastened for the purpose of attaching the upper end of the floatline.

Floats. The floats were 30-centimeter glass balls wrapped in heavy netting. A 15-centimeter loop on the float is made with three strands of 6-millimeter cotton twine for attachment to the pole. Two pieces of piuba 10 x 70 centimeters tied together (see Figure 18) were used in place of the glass float and found to be satisfactory.

b) Longline bait. The bait used for longlining were sardinha verdadeira (Sardinella aurita), sardinha lage (Opisthonema oglinum), sardinha cascuda (Harengula clupeola), peixe voador (Cypsilurus sp.) and mullets (Mugil sp.). The fish were used salted but may also be used fresh if there is some way to keep them frozen until ready for use. Salted bait does not spoil rapidly and may be used over again. The most satisfactory bait was the sardinha verdadeira from Rio de Janeiro. Bait caught locally were also used with good results.

c) Assembling the basket. Prior to setting, the mainline sections and branchlines are joined and the gear is coiled, first the mainline section then the branchline, alternating in this sequence until there are seven mainline sections and six branchlines assembled. The branchlines are set so that the hooks are placed one above the other, to facilitate baiting. The floatline is attached to the mainline and set on top of the basket. The end of the mainline at the bottom of the basket is set freely on the top of the coiled gear to facilitate joining to the next basket.

The coiled gear is then secured in a "skid." The "skid" was made up of 6-millimeter manila rope. Two lengths of rope 1½ meters long is used in making this simple "skid." One length is prepared with a 10-centimeter eye splice at the ends and the other length served at both ends.

The split bamboo baskets in which the coiled gear would ordinarily have been placed, were found to be bulky and occupied too much deck space. They were first replaced by canvas skids which were cut in the shape of an equilateral triangle, but they were later replaced by the rope skid which proved to be simpler and more economical.

d) Setting the gear. For setting the gear a table or chute is generally used (see Figure 19). On the "Albacora" the setting table was 60 x 150 centimeters, with one end secured to the rail and the other end supported by two sturdy legs with braces. The table was located just forward of midship.

The baskets are placed on the table, in order, and the skids removed. The hooks are pulled out from their positions with a small gaff and prebaited, the bait being hooked through the top of the head. The floatline and float are attached to the flag pole.

When setting the gear, the boat travelled at a speed of 4.5 knots. It was steered in a straight course with wind and sea about 20° off the port quarter. The setting procedure may differ from boat to boat depending on the side from which the gear is hauled in. The float assembly is pitched overboard, followed by the mainline section and the baited branchline. The first basket is attached to the second by joining the mainline at the bottom of the first to the mainline on the top of the second basket. This operation is repeated until the last basket, which is the same as the others, except that it has two floatlines, the last floatline supporting the end of the gear.

On the "Albacora" the gear was set at daybreak at about 05.15 hours, taking about 50 minutes to set 28 baskets. The gear is patrolled from time to time to check and see if any fish has been hooked; a sure sign is when a float bobs up and down.

e) Hauling the gear. Five to six hours after setting is allowed before retrieving the gear. On the "Albacora" this operation usually commenced at about midday and, depending on the catch and condition of the gear, was finished in about four hours. However, the work did not end then, as the catch had to be iced.

A line and net gurdy (figure 10) sent by FAO was used for hauling in the line (see figure 20), but before its arrival the hauling was done by hand. The gurdy was driven by the power take-off of the main engine by means of two V-belts. A simple clutch was mounted and operated by a hand lever.

To retrieve the gear, the boat pulls up to the end flag and with the boat hook, the float assembly is brought on board. The floatline is detached from the pole and passed through the fairlead and around the sheave of the hauler. The mainline passing through the hauler is pulled and coiled by hand. The man near the bulwark coils the branchline as it comes in and passes the coiled line to the man who is assembling the gear. He does the same with the floatlines. While the gear is being hauled in, it is also being assembled for the next day's fishing.

f) Use of bathy thermograph

A bathy thermograph (see Figures 16 and 17) with 330 meters of 3-millimeter stainless steel wire was supplied by FAO and used by the expert. Water temperatures down to about 140 meters were recorded daily on longline trips, as sea temperatures are believed to be of importance in longline fishing. With the information on temperature at the different depths, the fishing gear can be adjusted to fish in temperatures more favorable for tuna. Surface temperatures recorded varied from 25.0° C. to 27.2° C.; thermocline depths from 33 meters to 94 meters.

g) Species taken by longlining

The catches made by longlining consisted of a variety of tunas, spearfishes and other pelagic fishes as follows:

Table 4. Species of fish taken by tuna longlining

English	Brazilian (Local)	Scientific
Yellowfin tuna	Albacora de Lage	Neothunnus sp.
Big-eyed tuna	Albacora	Parathunnus sp.
Albacore	Albacora Cachorra	Germo alalunga
*Bluefin	Atum	Thunnus thynnus
Skipjack	Bonito de Barriga Riscada	Katsuwonus pelamis
Marlin	Agulhão	Makaira sp.
Sailfish	Agulhão Bandeira	Istiophorus americanus
Swordfish	Espadarte	Xiphias gladius
Dolphin	Dourado	Coryphaena hippurus
Wahoo	Cavala Alpim	Acanthocybium solandri
Barracuda	Bicuda	Sphyraena sp.

3. Pole and line (or live-bait) fishing

Pole fishing similar to the method used on the West Coast of the United States was carried out. Although there are not sufficient data to fully assess the potentialities of fishing by this method, it looks promising. The tuna reacted to chumming and some fish were taken by this method on the "Albacora". The catches were not significant due to the vessel's slow speed, the relatively small bait wells and the inexperience of the fishermen with this method. On one occasion, the school was frightened off when one of the fishermen dragged the tip of his pole in the water, and another time the bait supply was depleted before the school could be really fished.

The best time for pole fishing is between the months of September to December, when the schooling fish appear near the coastal waters. This method could also be employed during the seasonal fishing at Fernando de Noronha, Atol das Rocas and at the banks located about 60 miles north of Rio Grande do Norte.

* Taken by the Kaiko Maru No.13 on December 23, 1956 - Latitude 0°36' North Longitude 30° 35' West.
Yellowfin tuna taken by longline weighed between 58 to 95 kilograms, tuna taken near Atol das Rocas were smaller in size averaging, 25 kilograms.

The tuna schools are generally fast-moving, and for this reason a fast and maneuverable boat is required to get near enough to chum and fish the schools. The schools observed in the area are estimated at about 2 to 4 tons of small big-eyed tuna, 2 to 6 kilograms in size. Skipjacks are also found amongst these schools (see Figures 21 and 22). The best time of day to encounter these schools was in the early morning and late afternoon. Yellowfin tuna, of about 20 to 40 kilograms in size, were seen in the area of Fernando de Noronha. The fishermen report that this size yellowfin are sometimes taken by handline near the island.

Tuna schools may be found in several ways. Usually they are detected by flocks of birds hovering near the surface of the water. The presence of fish is indicated by the continuous diving of the birds to feed. A pair of binoculars is helpful when locating tuna by this method. In smooth seas, the presence of "breezing" schools is indicated by what appears to be a tide rip on the surface. Other ways of finding schools is by "jumpers," which are tunas jumping at the surface, and by fish strikes on the trolling lines.

When a school of fish has been sighted, the vessel approaches the school near enough to chum. The vessel is slowed down and the chummer begins throwing the live bait overboard, using a dip net about 30 centimeters in diameter to scoop the bait from the tank. When the fish begins to take the chum, handfuls of bait are rapidly thrown in the water to bring the school closer to the vessel. The vessel is stopped as soon as the fish begin to break water. The fishermen move into their fish racks (see Figures 14 and 15) with their poles and fishing begins. The jigs are moved on the surface of the water in a figure 8 pattern and occasionally splash water with the tips of their poles while in motion. When a fish takes the hook, the butt of the pole is quickly placed in the built-in U-shaped groove of the fish pad tied around the fishermen's waist, and with a pull the fish is lifted out of the water and swung onto the boat. With proper control, the fish can be shaken off the hook while being flung in the air over the shoulders. Because of the barbless hook used in this operation, it is necessary to keep the line taut when a fish strikes, otherwise the fish can shake itself loose from the hook with the least amount of slack.

a) Description of pole fishing gear (see illustration 5)

Selected bamboo poles and other accessory gear which were used for this method of fishing were obtained by FAO from California. Bamboos were also found locally and proved to be of good quality. The poles were cut 3.4 meters long, with a base of about 4 centimeters and a tip of about 2 centimeters in diameter. A small loop made with 6-millimeter cotton twine is secured to the small end of the pole. A 5-millimeter hard-laid cotton twine 2.4 meters long is secured to this loop with a swiveled attachment spliced to the end of the line. Two short lengths of stainless steel wire are joined to each other by loops made at one end of each length. One end of this two-piece wire is then attached to the swivel with a loop and the other is secured to the hook. A barbless hook inserted in a brass tube with lead was used. White selected feathers are secured to the shank to partially obscure the hook and to give the jig a more realistic appearance. Dried dolphin (dourado) fish skin is fastened at the indented lead part of the tube to form a protective covering over the feathers.

b) Bait fishing

Due to the strong running tide, the catching of bait was done at either high or low tides. The best results were obtained during low tide when the bait fish would school together, whereas, at high tide, they appeared to be widely scattered. During calm days, bait schools can be seen "breezing" on the surface.

Bait fishing was done with a jangada powered by a 4 h.p. Ponta outboard motor supplied by FAO. Later a 4.5-meter skiff was made, having a partitioned compartment, with the bottom perforated and screened to store the bait for transfer to the live bait wells on the "Albacora".

The result of the baiting operation performed by the "Albacora" indicates that there is only a moderate supply of bait in the ports, inlets, and estuaries between Recife and Natal. The scarcity of bait can be attributed to the fact that the smaller fishing craft constantly drag the beaches and inlets with their beach seines (mangotes).

The known baiting grounds are Recife, Cabedelo, Itapessuma and Natal. The most productive baiting area was in the port of Recife. During a short period spent on Fernando de Noronha, an abundant supply of sardinah cascuda was observed; however, care must be taken not to overfish the population. It is now being caught by the local fishermen for local markets. Being a fifth class fish, it has little commercial value and would be far more valuable if utilized as bait.

It seems probable that the bait resources of the region could support a small fleet of bait boats.

The beach seine first used by the expert for catching bait was made by the Fishery School of Tamandare (see Figure 11). The net was 60 fathoms long with a depth of 5 fathoms at the sack and 2½ fathoms at the wings. The wings were of No.9 cotton twine 7.6-centimeter streched mesh, the throat of No. 6 cotton twine 3.8-centimeter streched mesh and the sack of No.6 cotton twine 1.9-centimeter stretched mesh. The latter strip was the smallest mesh size that could be obtained at the time the net was constructed.

The above net, however, was not satisfactory for catching live bait as the fish were small and had the tendency to gill. Later a 30-fathom net (mangote) with a 1.3 centimeter mesh of No. 6 and 9 cotton twine was made. The entire net was hand-knitted and took nearly 6 (six) months to complete. The wings were 3 meters and the sack 6 meters in depth. The root of a tree (paná) cut into sections was used for corks to support the net. Lengths of rope 40 fathoms long were attached to the wings to increase the fishing area.

The common bait found in the northeast are the sardinha lage, sardinha cascuda, manjuba, arenque and pititinga (see Appendix A and Figure 12).

The sardinha lage (Opisthonema oglinum), a hardy bait is characterized by black spots on its green back. The sides are silvery and flat in shape. The smaller sizes ($7\frac{1}{2}$ to 10 centimeters), were used as live bait for pole fishing and the larger sizes (15 to 18 centimeters), for longlining. This species can be kept in a bait well for as long as eight days, or perhaps longer. The fish can be caught with a beach seine during the day, as well as at night, as they tend to concentrate around the night light.

When using sardinha lage as chum, it acts very wild and has a tendency to "sound." It is therefore necessary to minimize its active movements and weaken them by exposure to the air momentarily or by bumping the scoop net of bait against the coaming of the bait well.

This fish is the most abundant species suitable as bait found in the ports, inlets, and estuaries of the northeast.

The sardinha cascuda (Herengula clupeola) is relatively hardy and can be kept in a bait well for some time. The distinctive features of this fish are the large eyes and silvery body with large scales. The fish ranged from 5 to 15 centimeters in length. Large quantities of this species can be found in the bays of Fernando de Noronha island. In Baia de Sueste, as much as 15 kilograms were caught in one attempt with a cast net (tarrafa) of 3 meter diameter, $4\frac{1}{2}$ meters from the shore in a 1-meter depth of water. Because of the numerous coral heads in this bay, a bait skiff or receiver is necessary to transport the bait to the vessel outside the bay. This species is also found in small quantities in the ports and inlets of the northeast coast.

When used as chum for tuna, the reaction of sardinha cascuda is similar to that of the sardinha lage. The larger sizes (15 cm) were used for longlining.

The manjuba (Anchoviella, Anchoa, Anchovia spp.) is found in fair quantities, and with proper care can be kept in a bait well for some time. Unlike the sardinha, it is less active and is a good bait for pole fishing. It can be identified by the wide silver tripe running longthwise on each side of the body. This bait was removed from the bait net to the bait wells with a bucket partially filled with water, because of its fragility. Sizes ranged from 4 to 13 centimeters.

The arenque (Anchoviella, Anchoa spp.) is a small, delicate, translucent fish with a silver stripe on each side of the body. This fish was found to be from 3 to $6\frac{1}{2}$ centimeters long. They had to be handled with even greater care than the manjuba and because they are not hardy, it is necessary to use them a day or two after they have been caught.

When used as chum for tuna, the bait tends to swim lazily on the surface of the water near the vessel and was found to be very suitable for tuna ranging from 2 to 6 kilograms.

This bait can be caught only with fine meshed nets, either the beach type or lift nets, at night. Sizeable quantities of *arenque* were found milling around the night light in Recife and Natal.

The *Pititinga* (Fam. *Engraulidae*) is a hardy bait, round and slender in shape with a silver band on each side of the body. The edge of the tail has a slight tint of red. Like the *arenque* it tends to remain on the surface of the water and close to the vessel when used as chum. It could be kept in the bait well for at least six days. This bait, however, was found in small quantities only.

V. JAPANESE TUNA FISHING OFF THE BRAZILIAN COAST

In early 1956, representatives from Japan came to Recife for the purpose of establishing a fishing industry. The result of the visit was the arrival of the 352-ton Japanese longline vessel, the "Kaiko Maru No. 13" with a crew of 31 men, in mid-July 1956. This vessel is 38 meters long, of steel construction and powered by a 650 h.p. diesel engine with two auxiliaries 100 and 75 h.p. respectively. The refrigerated fish hold is 412 cubic meters; fishing equipment included two line haulers (one a spare) and 400 baskets of longline gear. On her first trip the "Kaiko Maru" arrived in Recife with 150 tons of frozen filleted and eviscerated fish caught in 26 days of fishing in the Atlantic off the Northeastern coast of Brazil. The following table lists the first trip's catch.

TABLE 5. Main Species of Fish taken by the "Kaiko Maru No.13" - First Trip

Species	No. of fish	Percentage of catch
Yellowfin tuna	2,467	77.2
Albacora	570	17.9
Big-eyed tuna	55	1.7
Marlin	92	2.9
Swordfish	9	0.3
	3,193	100

The best catch was taken at latitude 03° 04' North, longitude 39° 41' West, where 328 yellowfin, 63 albacore, 2 big-eyed, 6 marlin and 3 swordfish were taken in one day, giving an average of 23 fish per 100 hooks.

From 29 July to 31 August, the expert went on a longline fishing trip on the "Kaiko Maru No. 13" (second trip) with four Brazilians, three of them crew members of the "Albacora" and the fourth a student from the Escola de Pesca de Tamandare. The total catch, after 25 days of fishing time, was 160 tons of filleted and eviscerated fish. The following table lists the second trip's catch:

TABLE 6 Composition of Catch taken by the "Kaiko Maru No.13" - Second Trip

Species	No. of fish	Percentage of catch
Yellowfin tuna	3,005	87.4
Albacora	207	6.0
Big-eyed tuna	30	9
Marlin	193	5.6
Swordfish	5	1
	3,440	100

TABLE 7 Dates and Location of Best Catches taken by the "Kaiko Maru No.13" Second Trip

Date	Position	No. of fish per 100 hooks
11 August	Latitude 05° 14' North - Longitude 40° 28' West	19.8
15 August	" 05° 34' " - " 40° 59' "	25.5
20 August	" 05° 15' " - " 41° 05' "	24.7
21 August	" 05° 17' " - " 40° 58' "	23.5

The catches of the "Kaiko Maru" were sold to the fish markets in Recife and João Pessoa. The consumption of large fresh fish in these ports increased from 1 ton per day from the catches of the "Albacora" to nearly 15 tons per day from the "Kaiko Maru". The large supply of tuna and spearfishes resulted in a marked drop in the price of tuna, from Cr. $50,00 to Cr. $30,00 per kilo to the consumer. The "Kaiko Maru No. 13" was able to make four trips in six months, bringing in a total of 650 tons of fish.

TABLE 8 Summary of Data for the "Kaiko Maru" First Two Trips

	Trip No.1	Trip No.2
Average No. of baskets fished per day	318.7	305.6
Average No. of hooks fished per day	1,593	1,310
Average No. of fish caught per day	122.8	137.7
No. of fish per 100 hooks	7.7	10.5

The following are the prices fixed by the COAP (Commissão de Abastecimento e Preços) on the "Kaiko Maru" fish.

TABLE 9 Fish Prices for the "Kaiko Maru" Catch

State	Vessel's share per kilogram in Cr. $	Retail price in Cr. $
Fillets	23.00	30.00
Eviscerated	21.00	25.00
Round	19.00	22.00

TABLE 10 Taxes Imposed on the "Kaiko Maru" Catch
(Based on Cr.$20.00 per kilogram)

	Tax per kilogram	Amount
Caixa de Credito	3 percent	Cr.$ 0.60
Taxa Bromotologico	1½ "	0.30
Vendas e Consignacões	5 3/4 "	1.15
Imposto de Entrada a Prefectura	½ "	0.10
	10 3/4 "	Cr.$ 2.15

On 18 December 1956, the "Sagami Maru", a 56-meter Japanese longline vessel of 700 tons, arrived in Recife with 230 tons of fish. The vessel is of steel construction, powered by a 1,250 h.p. diesel engine capable of making 12 knots and manned by a crew of 40. The captain reported that 40 percent of the catch was albacore (Germo alalunga), caught around Latitude 05° 17' South and Longitude 25° 47' West. A few bluefins were also taken in the area. Part of the catch was unloaded in Recife and the remainder in Salvador, Bahia. It is reported that at least two more longlinersare due to arrive in Recife in early 1957.

VI. CURRENT PROGRESS ON TUNA FISHING DEVELOPMENT

There has been a great deal of interest in longlining. The "Empresa de Pesca do Paraiba", a recently formed organization, which has an 11-meter boat, is now carrying out this type of fishing. With equipment purchased locally and some on loan from FAO, 20 baskets of longline gear were made up. A crew member of the "Albacora" who was trained by the FAO expert has joined the group and instructed them as to how to make up the gear.

The Governor of Fernando de Noronha is planning to use the 19-meter trawler "Santa Alice", for longlining. Lines, floats and hooks were ordered from Rio and São Paulo and the trained counterparts of the expert will supervise the construction of the gear.

Some artificial lures were provided to the fishermen for trial in Baia Traicão, Baia Formosa, Natal and Rio de Fogo. The reports received were favourable and there were requests for more.

The "Rubi" cannery of Rio de Janeiro was interested in canning tuna. They asked for and received some albacore (Germo alalunga) from the expert, which they used for trial canning. The pack proved to be quite good. There is a possibility that the company will establish a cannery in the northeast if the production of tuna increases.

VII. CONCLUSIONS

1. Too much time is lost by the fishermen because of lack of or inadequate harbor facilities and installations for small fishing craft.

2. Most of the botes in the northeast are suitable for mechanization. Inboard engines 10 to 12 h.p., produced nationally in Brazil could be installed on these craft.

3. Outboard motors of 2-3 h.p. could be used on the cancas doing inland fishing, enabling them to work with smaller crews and to make more and faster sets with their net.

4. It is doubtful whether outboard engines would work on jangadas as the craft provides no protection from the sea. Furthermore, the jangada fishermen have to operate with as little cost as possible. Having an engine would not help to significantly increase their catches, as most of them are engaged in pot fishing (covos). The jangada-bote, however, can be mechanized with the use of outboard engines.

5. The present fishing craft and the methods used limit fishing activities to coastal waters. The types of fishing craft used do not allow intensive fishing all the year round, and during the rough seasons production is reduced considerably. The introduction of larger motorized boats would enable the fishermen to fish further out.

With mechanization, the botes will be able to go faster out to sea and possibly fish with longline. Multiple trolling could also be employed.

Inboard engines are available at the "Stoll Irmaos" and J. Alfredo Moldenauer, both located at Joinville, Santa Caterina. The prices FOB factory are as follows :

TABLE 11 Prices of Inboard Engines Manufactured in Brazil

4 to 5 h.p.	one	cylinder	motor	Cr.$9,000
6 to 8 h.p.	"	"	"	12,000
8 h.p.	two	"	"	18,000
10 h.p.	"	"	"	26,000
12 h.p.	"	"	"	35,000

6. Fishing vessels 25 meters in length with a fish hold capacity of about 50-60 tons, equipped with refrigeration, a Japanese longline hauler, 150 baskets of tuna longline gear and with a crew of nine fishermen would be able to fish in the area where the Japanese vessels have been active. A vessel making 8 knots, based either in Fortaleza or Natal, could reach the fishing area in two and a half to three days.

The vessels must, however, have the pilot house slightly aft of midship, giving the man on the wheel a clear vision of the fishing operation. To fish the maximum amount of gear, a Japanese longline hauler must be mounted on the foredeck, a short distance away from the starboard bulwark, with plenty of room for movement within that area. The hauler can be driven either by an electric motor or by a power take-off from the main engine. A fairlead with vertical and horizontal brass

rollers must be mounted on the starboard rail and in line with the hauler to prevent the incoming lines from chafing. A storage space for the floats and baskets must also be provided, aft of the pilot house, and a rack located on the starboard bulwark aft consisting of two U-shaped frames, as storage space for the bamboo poles. For setting the gear, a working table should be fitted on the quarter deck.

A working table about 60 to 150 centimeters must be made and fitted to the height of the hauler, so that the main line passing through the hauler coils properly on the table. The remainder of the table provides space for assembling the gear. Strong fish gaffs with a 120-to 150-centimeter handle must be provided to haul the fishes on board.

VIII. RECOMMENDATIONS

1. Improvement of entrepostos

Any future entrepostos catering to fishermen should be located at the docks where their facilities would be readily available. If possible, they should produce enough ice and have sufficient refrigeration space to meet the demands of the fishermen. There should be installed on the dock at the main ports at least one water tap with sufficient length of hose to reach the tanks of the fishing boats. Study should be made of the feasibility of erecting an ice-making plant at the entreposto in Natal to provide cheap ice for the fishermen and of the need of increased ice production and refrigerated space at the entrepostos in João Pessoa and Recife. The latter should also have an ice-crushing machine and a diesel oil fuel pump installed to service the fishing industry.

2. Financial aid to the fishing industry

The slow development of the fishing industry is attributed to the inability of the fishermen to invest in larger boats and to employ more productive fishing gear. If there is a desire to develop the fishing industry, the Government and, possibly, private industry should encourage fishermen to purchase larger boats by partially financing them or granting them loans at low rates of interest.

Mechanization of the fishing boats will be slow because the fishermen are usually not in a financial position to make such a big purchase as an engine. Mechanization of the boats will undoubtedly need the support and guidance of the Government. Loans could be extended to the fishermen to make such a purchase or the Caixa de Credito could make such engines available on an easy payment plan.

A government agency, most likely the Caixa de Credito should make fishing equipment available for purchase by the fishermen, either nationally produced, if obtainable, or imported, such as tuna hooks, leader wires, swivels, hard-laid cotton lines, glass floats, and line hauler for long-lining; artificial lures, hooks, leader wires, swivels, rubber shock absorbers for trolling and pipe squid hooks, leader wires and swivels for pole fishing.

3. Extension service facilities for the fishermen

Since there are no boatyards in the northeast capable of installing marine engines satisfactorily, the respective engine manufacturers or dealers concerned or the Government should provide competent mechanics to assist the fishermen in installing their engines. The fishermen will also need much more technical advice on the operation and maintenance of their engines in the mechanized craft. Failure to make simple repairs of the engine on the "Albacora", while out at sea, were experienced, necessitating the use of the auxiliary sail to return to port. Any competent mechanic who can therefore be made available, either by the engine manufacturer or dealer or by the Government, to help the fishermen in the installation of engines should also give instruction concerning the proper operation, maintenance and repair of engines. A ready supply of engine parts should always be made available. The Government may also wish to include a course on the maintenance, operation and repair of marine engines at the Escola de Pesca de Tamandaré.

The Government should make every effort to utilize the experience gained by the expert's counterpart assistants and continue the work initiated by him. The counterpart assistants should not only be used to instruct students at the Escola de Pesca de Tamandare, but also give technical advice and practical demonstrations to the fishermen in the various villages of the northeast.

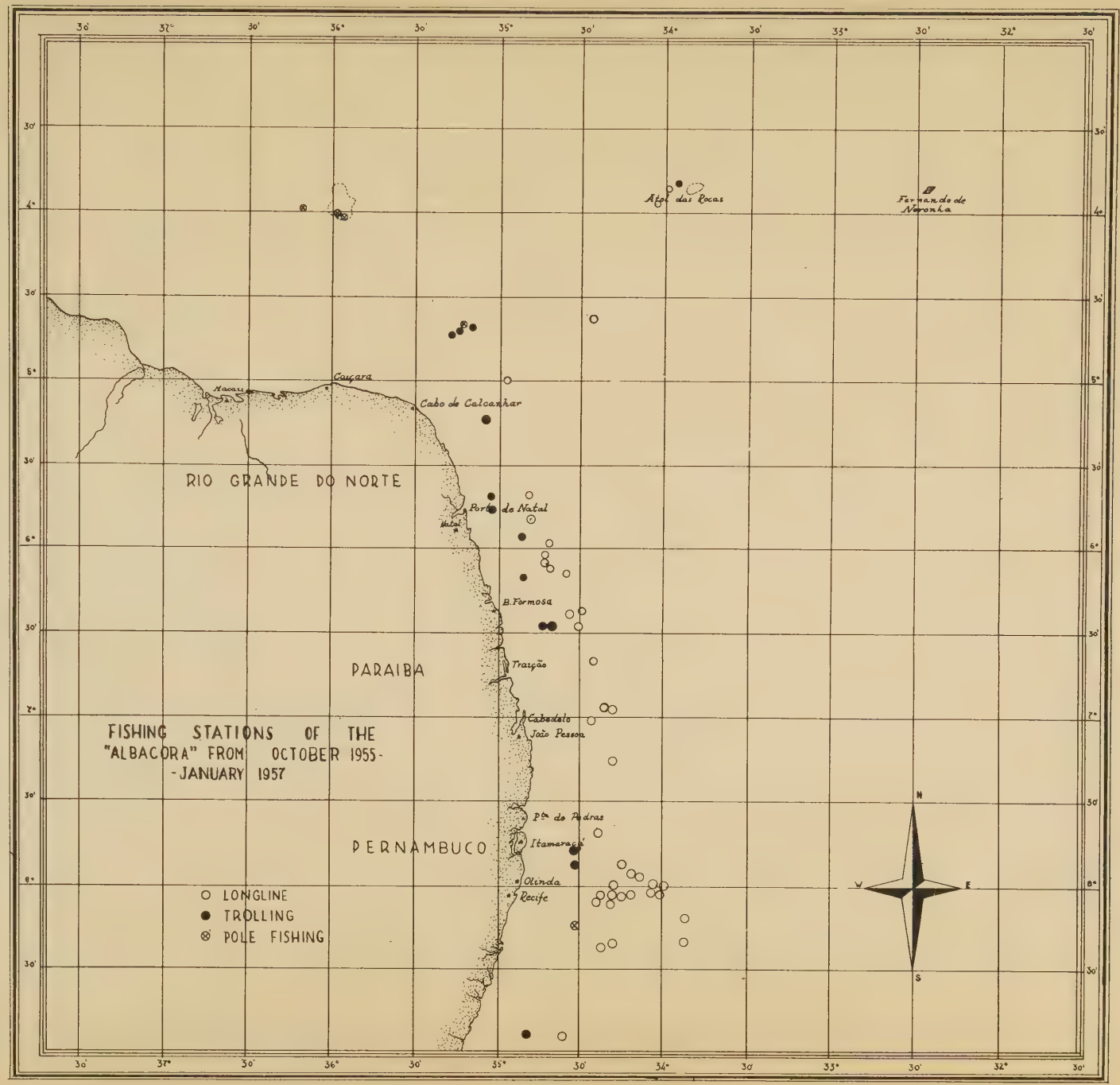
The Government should take advantage of the provision in its contract with the Japanese fishing company and place Brazilian fishermen on the vessels for training. It should be emphasized that training experience should not be confined to fishing only but some men should also be trained, so that a number of them may eventually qualify as skippers, refrigeration mechanics and engineers. When they have gained sufficient experience, they should be able to carry on fishing-operations on their own initiative. It may then be necessary to assist them with capital to obtain their own craft.

The Escola de Pesca de Tamandare should also include in its curriculum a course in celestial navigation, to be taught by a competent instructor, and give such practical courses to skippers in the area at convenient periods, so that the fishing boats can go out further off the coast and be able to navigate to and from more productive distant fishing grounds which are at present beyond the reach of the existing boats.

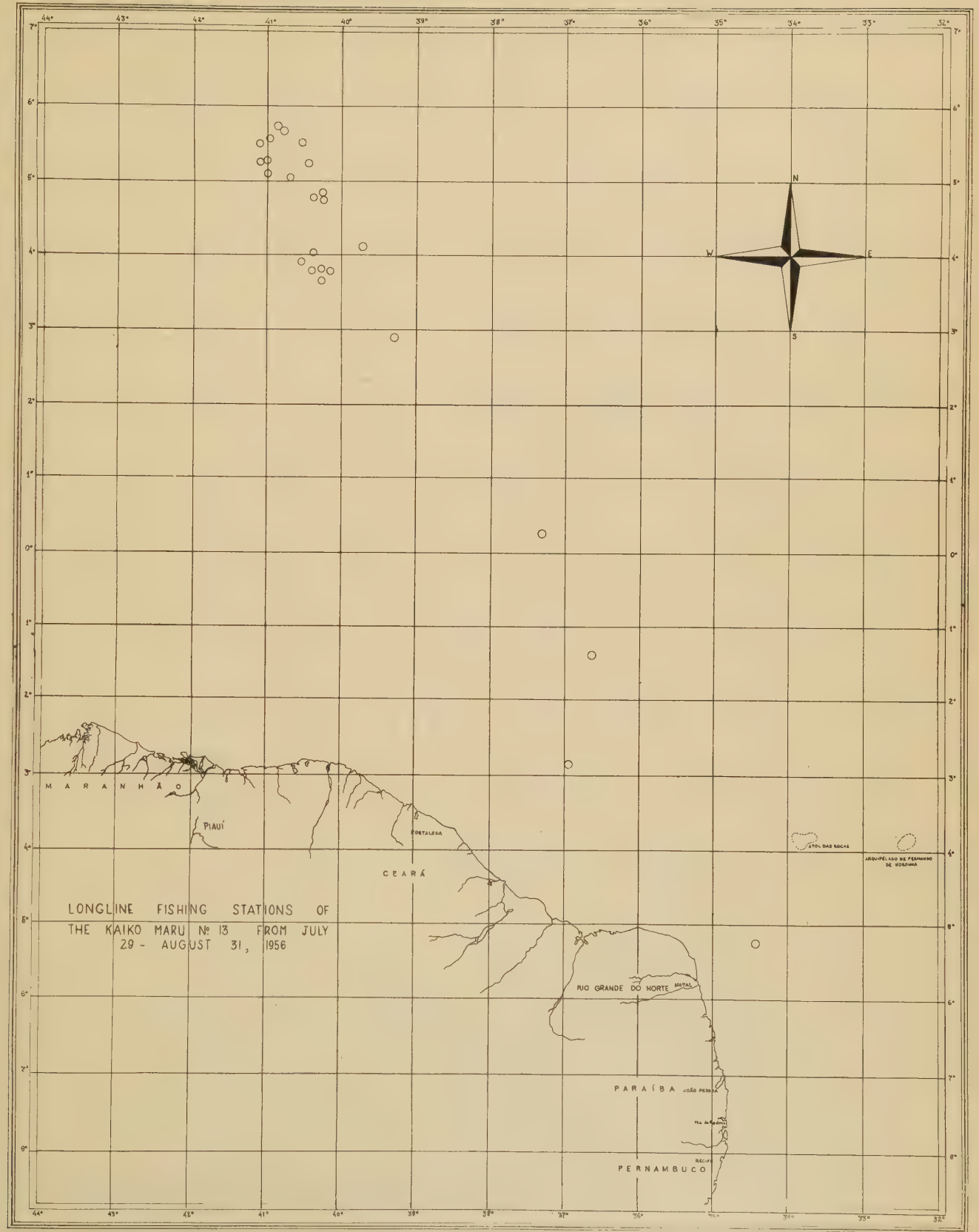
APPENDIX A

List of Fishes (other than Tuna) mentioned in the present Report

Brazilian (local)	English	Scientific
Agulha	Needlefish	Strongylura sp.
Arenque	Anchovy	Anchoviella, Anchoa spp.
Bagre	Catfish	Arius spp.
Barbuda	-	-
Camorin	Snook	Centropomus undecimalis
Carapeba	Mojarra	Diapterus rhombeus
Curimã	Striped mullet	Mugil cephalus
Espada	Atlantic cutlassfish	Trichiurus lepturus
Galo	Moonfish	Selene vomer, Vomer setapinnis
Guarajuba	Jack	Caranx latus
Manjuba	Anchovy	Anchoviella, Anchoa, Anchovia spp.
Peixe voador	Flyingfish	Exocoetus sp.
Pescada	Weakfish	Macrodon ancylodon
Pira	-	-
Pititinga	Anchovy	Fam. Engraulidae
Sardinha	Smooth sardine	Sardinella aurita
Sardinha cascuda	Sardine	Harengula clupeola
Sardinha lage	Thread herring	Opisthonema oglinum
Sardinha verdadeira	Smooth sardine	Sardinalla aurita
Sargo	Sheepshead	Archosargus sp.
Tainha	Mullet	Mugil spp.

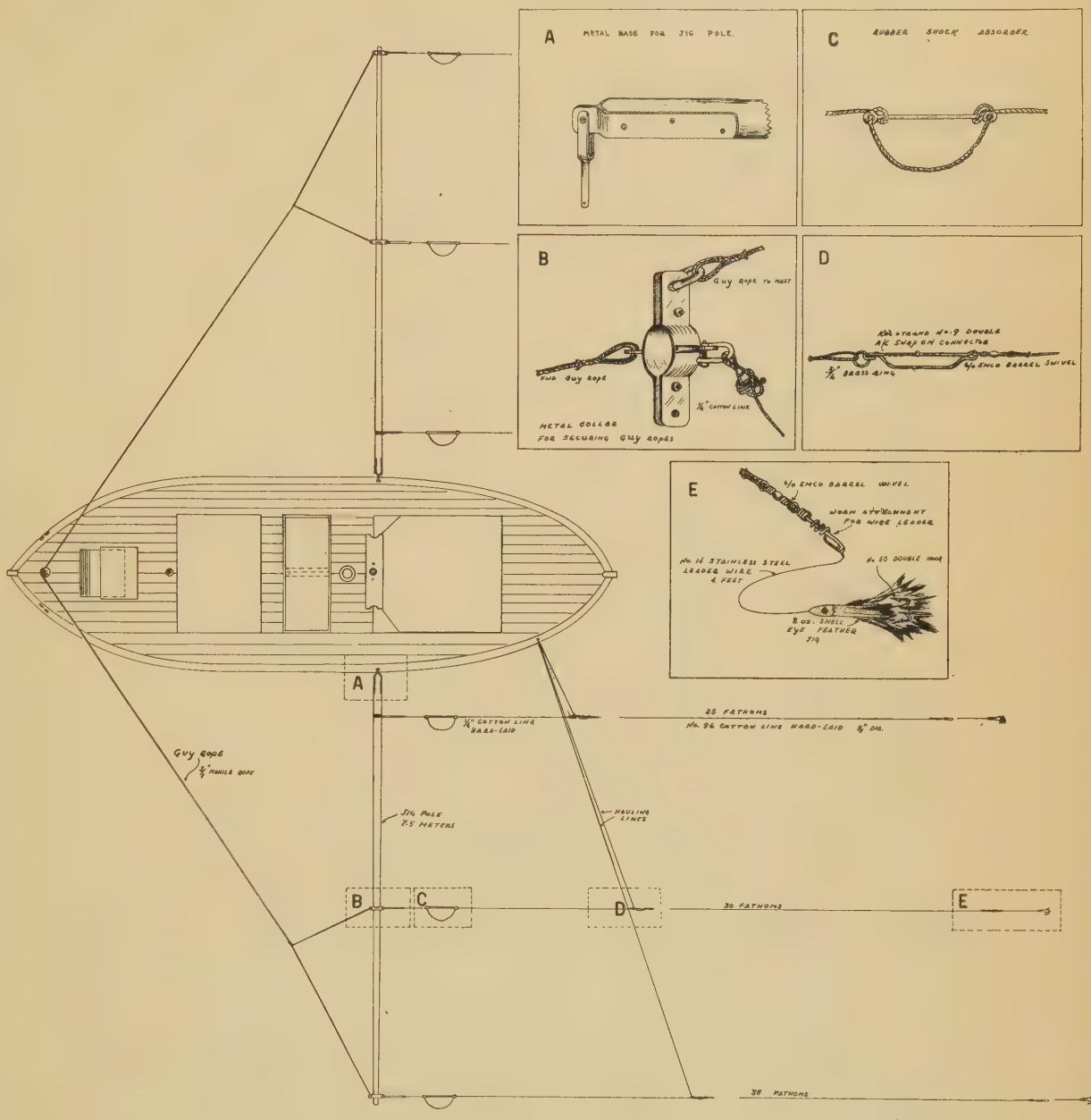

Atol das Rocas
Fernando de Noronha
Macau
Cauçara
Cabo de Calcanhar
RIO GRANDE DO NORTE
Porto de Natal
Natal
B. Formosa
PARAIBA
Traição
Cabedelo
João Pessoa
FISHING STATIONS OF THE "ALBACORA" FROM OCTOBER 1955 - JANUARY 1957
Pta de Pedras
PERNAMBUCO
Itamaracá
Olinda
Recife
LONGLINE
TROLLING
POLE FISHING
N
W
E
S

7M. 754



LONGLINE FISHING STATIONS OF THE KAIKO MARU Nº 13 FROM JULY 29 - AUGUST 31, 1956

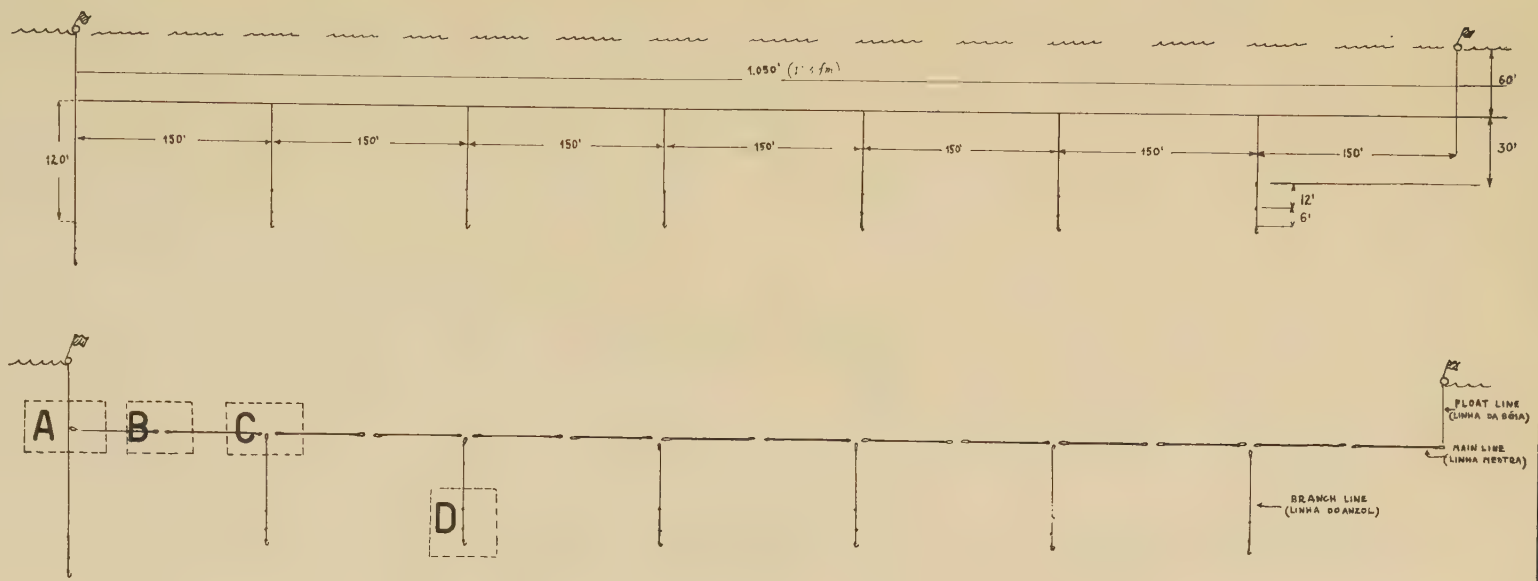
DIAGRAM SHOWING CONSTRUCTION OF GEAR FOR MULTIPLE TROLLING
[CORSO]

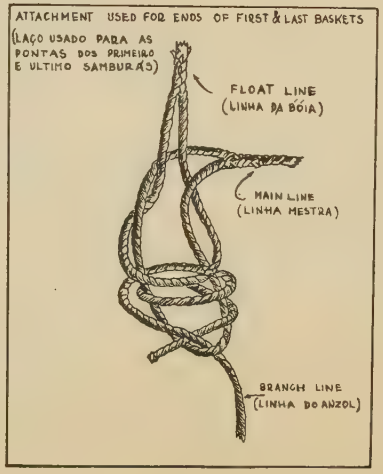


DRAWN BY: A. Lubowski

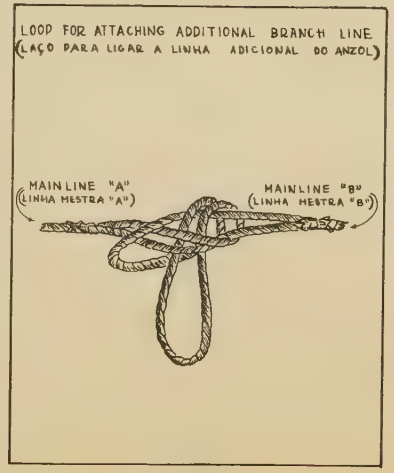
ADVISED BY: Robert E. K. D. Lee
FAO FISHERY ENGINEER.

DIAGRAM SHOWING CONSTRUCTION OF LONG LINE GEAR [ESPINHEL] PARTE I

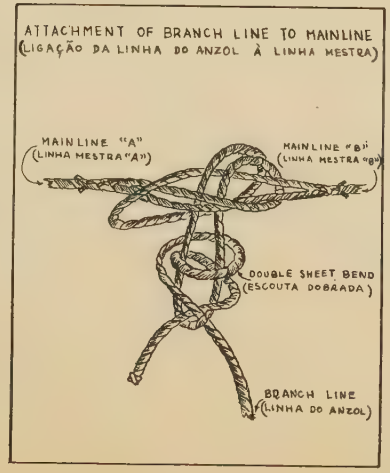



ATTACHMENT USED FOR ENDS OF FIRST & LAST BASKETS
(LAÇO USADO PARA AS PONTAS DOS PRIMEIRO E ULTIMO SAMBURÁ(S))
FLOAT LINE
(LINHA DA BÓIA)
MAIN LINE
(LINHA MESTRA)
BRANCH LINE
(LINHA DO ANZOL)

A


LOOP FOR ATTACHING ADDITIONAL BRANCH LINE
(LAÇO PARA LIGAR A LINHA ADICIONAL DO ANZOL)
MAIN LINE "A"
(LINHA MESTRA "A")
MAIN LINE "B"
(LINHA MESTRA "B")

B

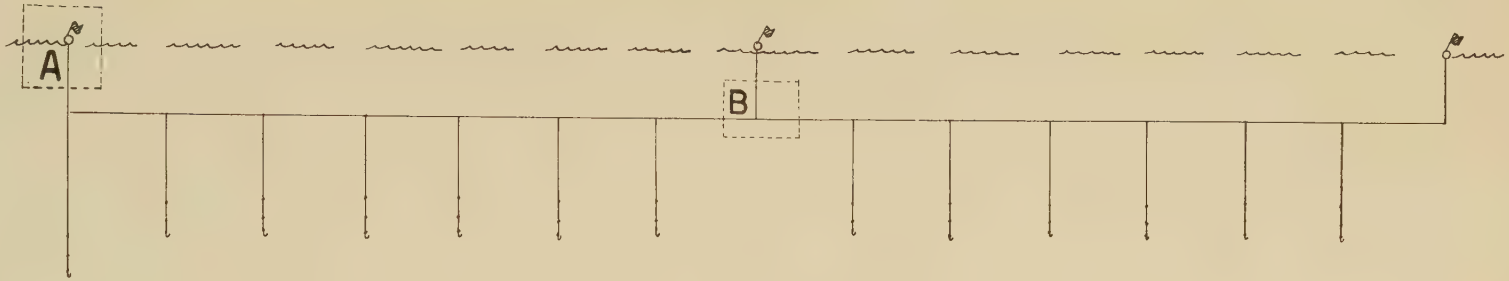


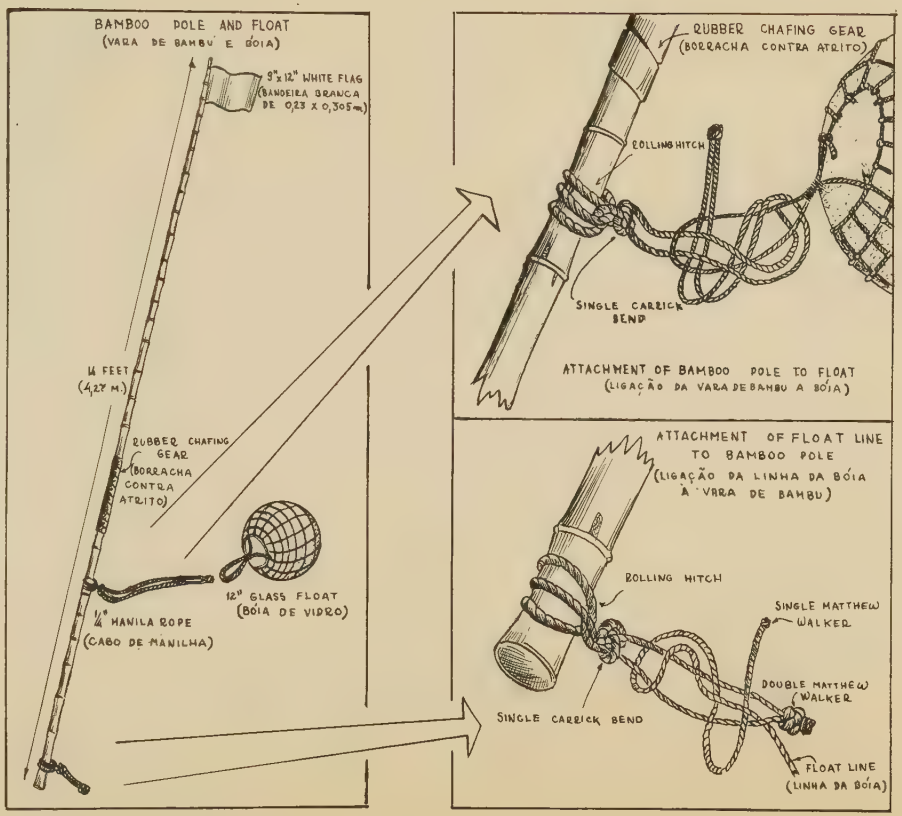
C

ASSEMBLY OF BRANCH LINE
(CONJUNTO DA LINHA DO ANZOL)
No. 10 BRASS SWIVEL
(DESTORCEDOR DE LATÃO)
SEKIYAMA 12' LONG
(" " 3,66 M DE COMPRIMENTO)
1/16" GALVANIZED WIRE - 6' LONG
(ARAME GALVANIZADO DE 1/16" E 1,83 DE COMPRIMENTO)
9/0 TUNA HOOK
(ANZOL DE ATUM)

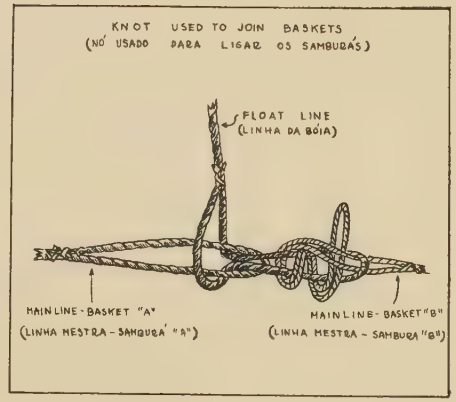
D

DIAGRAM SHOWING CONSTRUCTION OF LONG LINE GEAR [ESPINHEL] PARTE II





A


KNOT USED TO JOIN BASKETS
(NÓ USADO PARA LIGAR OS SAMBURÁS)
FLOAT LINE
(LINHA DA BÓIA)
MAINLINE - BASKET "A"
(LINHA MESTRA - SAMBURÁ "A")
MAINLINE - BASKET "B"
(LINHA MESTRA - SAMBURÁ "B")

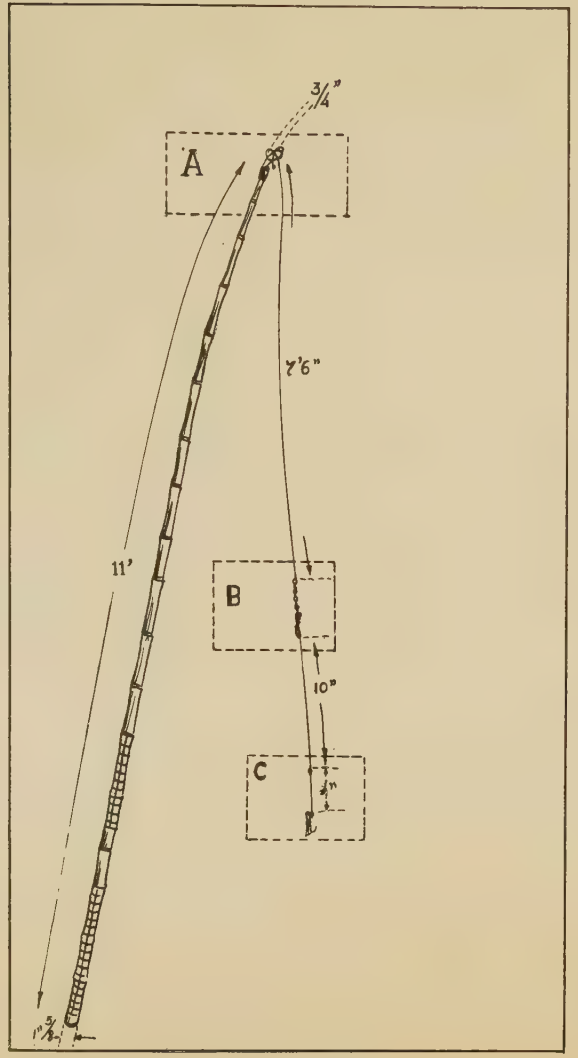
B

DRAWN BY

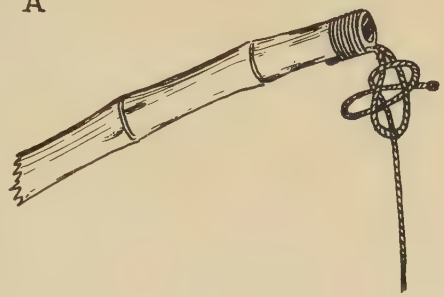
ADVISED BY

FAO FISHERY ENGINEER

DIAGRAM OF BAMBOO POLE USED IN POLE FISHING FOR TUNA



A

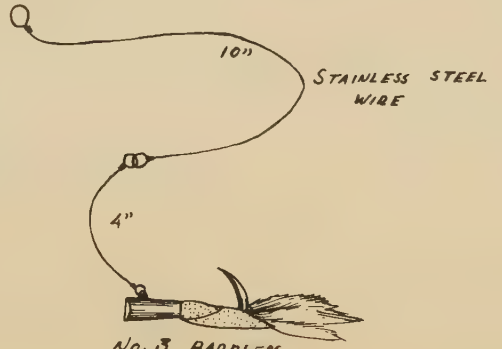


ATTACHMENT OF HOOK LINE TO POLE

B

SWIVEL AND LEADER WIRE ATTACHMENT

C LEADER WIRE AND BARBLESS PIPE SQUID

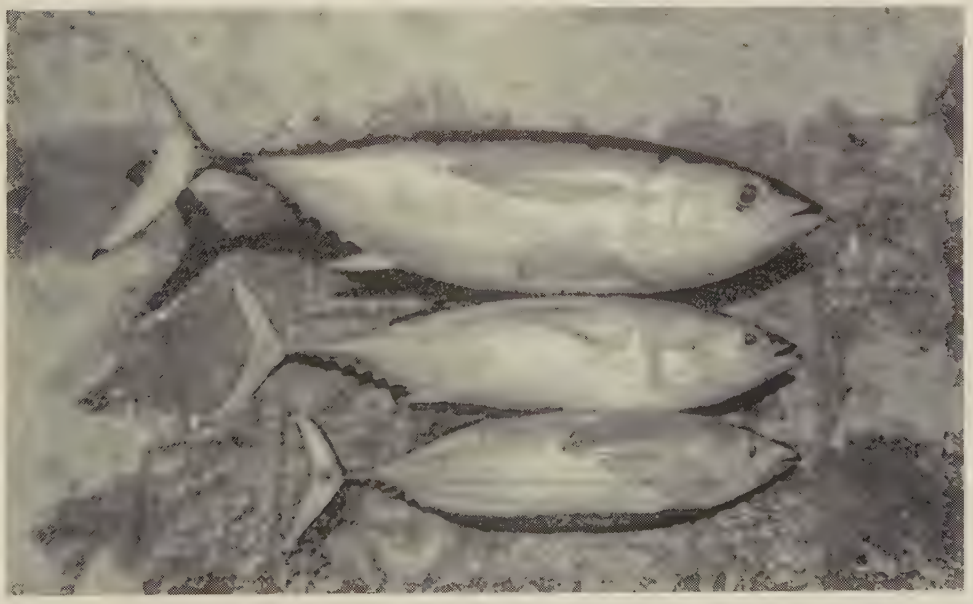


Robert E.K.D. Lee

PHOTOGRAPHS

Figure 1. The expert with a 23-pound skipjack.

Figure 2. Top to bottom: big-eye tuna, frigate mackerel and skipjack.



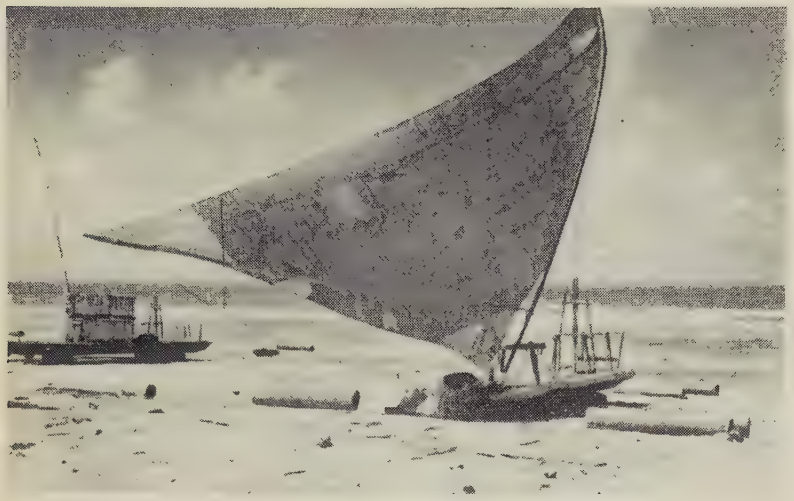


Figure 3. A typical *jangada* with sail.

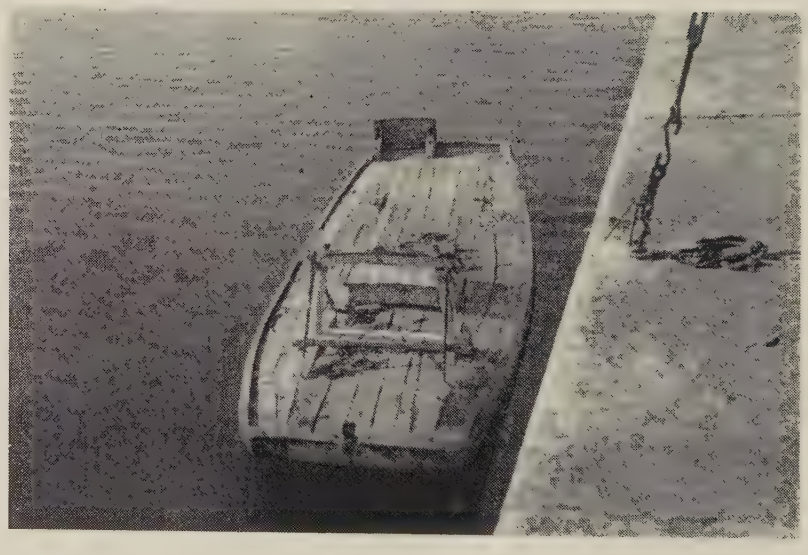


Figure 4. A *jangada-bote* with outboard engine mount.

Figure 5. The *entroposto* in Recife.

Figure 6. The open fish stall in Recife.

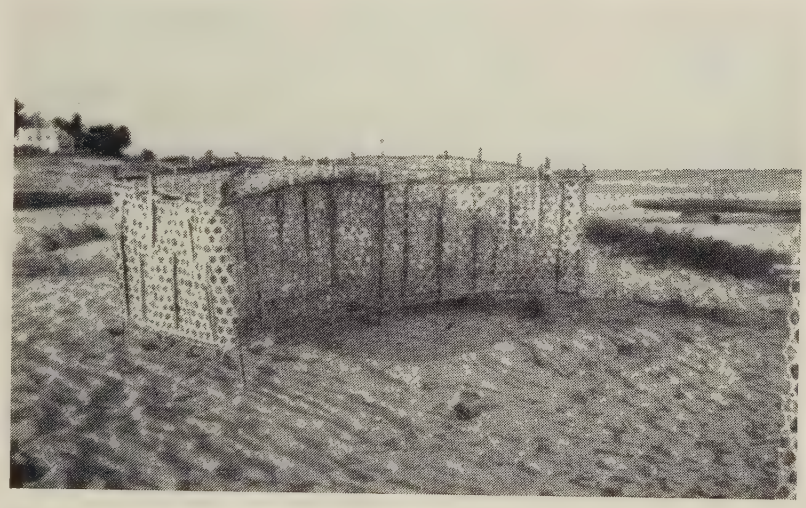


Figure 7. A *covo* (fish pot) for lobsters and small fishes.

Figure 8. Botes loading ice and water in barrels.

Figure 9. The ice crusher introduced by the expert.

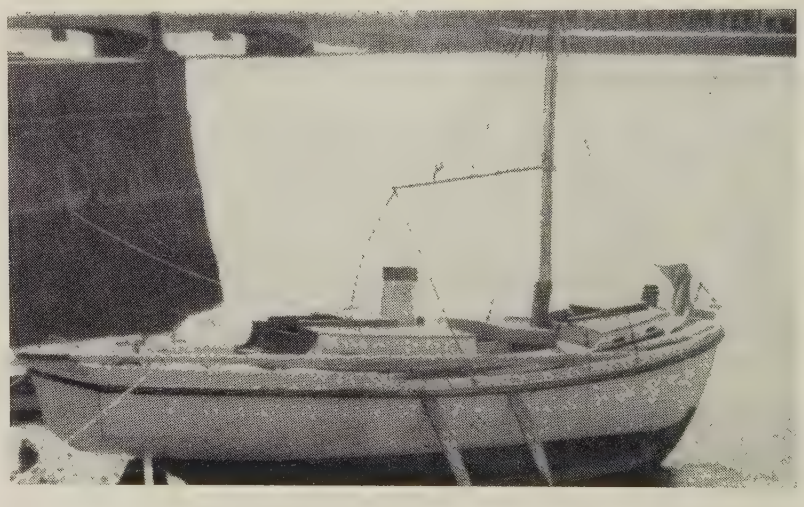


Figure 10. The 8-meter "Tamandare I".

Figure 11. The "Albacora" at anchor.

Figure 12. Norwegian line and net gurdy installed on the "Albacora".

Figure 13. Hauling for live bait with beach seine.

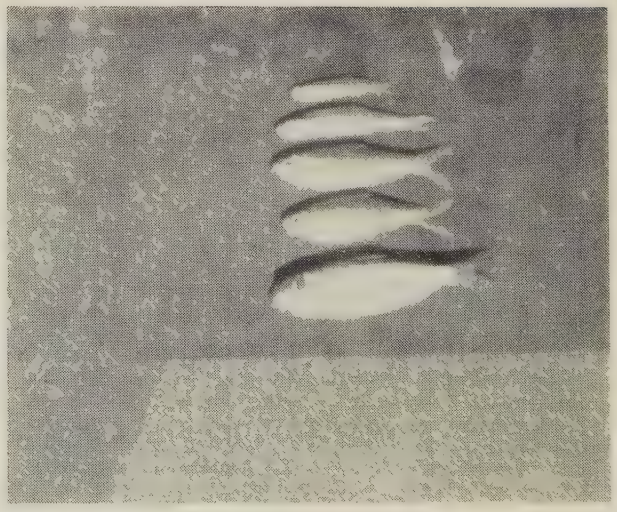


Figure 14. Bait fishes (top to bottom): *arenque, arenque, manjuba, sardinha lage, sardinha cascuda.*

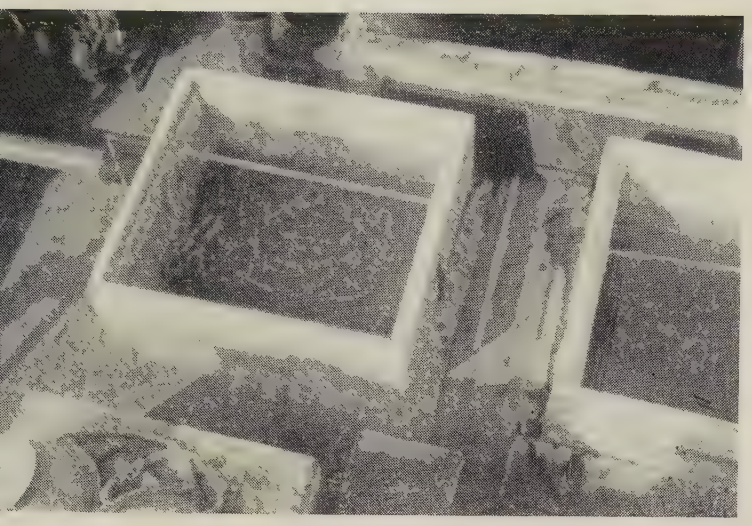


Figure 15. Bait in the wells of the "Albacora".

re 16. Fishing racks for pole line fishing on the "Albacora".

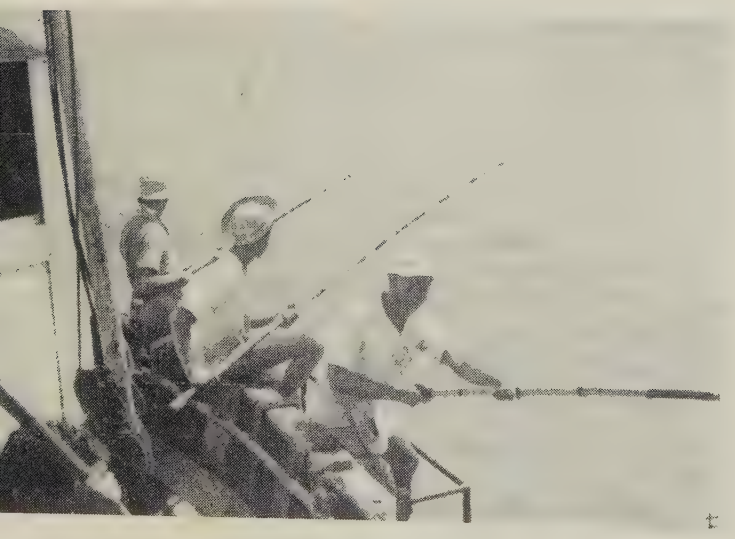


Figure 17. Pole and line fishing on the "Albacora".

Figure 18. Bathythermograph being cast overboard.

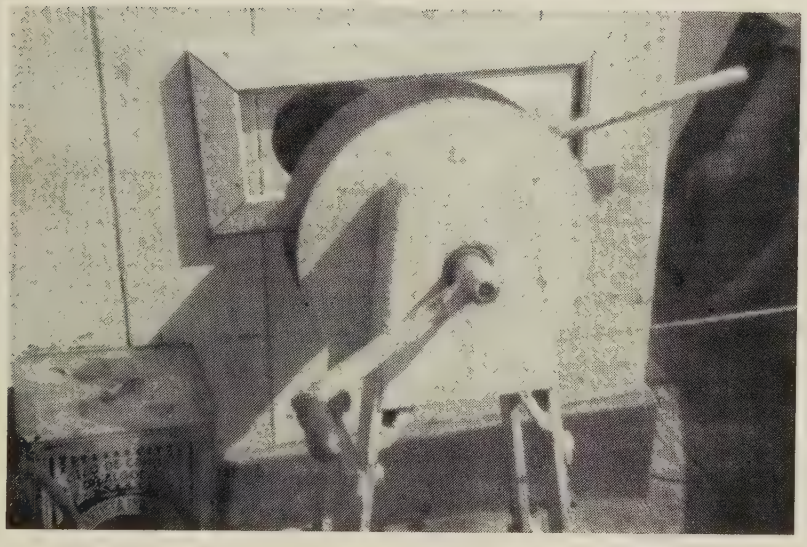


Figure 19. Hand-operated winch made by the expert and installed on the "Albacora" for taking bathythermograph casts.

Figure 20. Piuba wooden float – used also in longlining.

Figure 21. Baiting a hook during setting of the longline gear.

Figure 22. Hauling in the longline gear with the Norwegian gurdy.

Figure 23. "Albacora" crew member tying pole to float on "Kaiko Maru".

Figure 24. Hauling longline gear; second trip of "Kaiko Maru".